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IOT Solutions for Farmers on Livestock Management in Smart City: A Bibliometric Survey

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IOT Solutions for Farmers on Livestock Management in Smart City: A Bibliometric Survey

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Abstract: With modernize city approach, concept of IOT – Internet of things achieving popularity and becoming major source for smart innovations. Added advantage of internet application the technology enables sensing, processing and execution automatically and remotely on finger tip. IOT makes sure an easy availability and access to the information available at any corner of the world. In growing countries like INDIA, increase in urbanization led infrastructure expansion; most of the urban cities are now expanding in nearby towns and villages. So towns and villages are merging and becoming part of nearby cities. So the farms, farmer community and their domestic animals (livestock) are surrounded by concrete and eastern life style. Purpose behind this survey is to provide a bibliographic survey on IOT managed smart solutions to the farmers on their day-to-day work, loose housing, dairy farm and managing livestock to balance quality of life style in urban society towards achieving smart city target

Keywords: *IOT – Internet of things, Smart City, Livestock, Loose housing animal farm, smart farming.*

1. INTRODUCTION

With urban expansion the nearby towns and villages are now merging in to cities and surrounded exploring a concrete and western life style. Towards smart city concept in this mixed lifestyle, balanced development is a major prerequisite to sustain in shared society, achieve economic growth and lifestyle quality balance. In INDIA by tradition most of the farmer communities in town and village use to keep domestic animals like buffalos, cows, goats, ships and hens (called as live stock) to earn financial income mostly by selling milk, eggs as a family house own business. To keep the domestic animals traditional loose housing farm concept is followed mostly for livestock management.

To support farmer's day to day work and livestock management by using smart solution has become a great need in order to balance the life quality of human being and domestic animals. Countries like South Korea, USA and China has already started gaining benefits from IOT application and INDIA is also proceeding in the same direction. IOT smart solutions can satisfy needs by improving environment, smart renewable energy resources and increasing animal health with innovative sensor monitoring and data processing technology. Milk and Milk products are more demanding products so in order to compete the market the quality of milk and production needs to improve. IOT based digital revolutions allows farmer to monitor, maintain and process the product in "scientific" and "intelligent" way by using "precision" farming practices.

2. IOT SMART SOLUTIONS

The Internet of Things connects devices such as everyday consumer objects and equipment onto the network, allowing data, information gathering and smart management of these devices using software to enhance efficiency. It enables new services to achieve health, safety and environmental benefits in smart way. In this section topic is divided in to smart IOT applications as a) Geofencing to monitor and track animal movement, b) Wearable wireless sensors for

animal health monitoring and disease detection, c) Use of renewable energy to facilitate electricity need for livestock house and its smart use by applying IOT technique.

2.1 Geofencing – This technology has gained boom in farmers for tracking their domestic animals online in real time. GPS tags are applied to animals and through the tags information is transformed by using GPS, Wi-Fi, and RFID on mobile or monitoring software's. It is nothing but applying digital boundary to animal movement, monitor and manage livestock efficiently [1]. If in case of animal theft or any animal entering in any apartment, play area or any danger zone then farmers receive information in real time and take actions immediately.

Figure 1. Solar powered GPS Tags

The tags can record data like calving dates, Harmon's, vaccination, weight gain/loss, medication, illness tracking and provide visual information of individual animal performance. Figure 2 shows GPS tag which operate on solar powered battery so no electricity required powering it [2]. It can monitor animal 24 by 7 and update information with specific frequency [2].

2.2 Wearable Wireless Sensor to monitor animal's health – Animals can catch various diseases due to plenty of reasons. Daily it is not feasible to check each and every animal manually because it's difficult and time consuming. Because of disease contagious nature possibility to spread in other animals if not detected in time. This will result in decreasing milk quantity and quality. Various wireless wearable sensors are available to mount on animals. These sensors can be applied to various parts of animal like, neck, tail, or leg to obtain real time information to understand various behaviour of an animal [3]. These wearable sensors can sense temperature, activity, change in behaviour like lying down frequently, eating habits, splitting

from herd, milk production and fertility management. With this animal dieses and illness can be detected on spot.

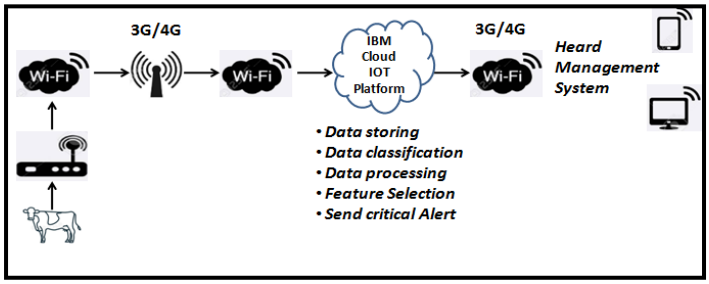

Figure 2. IOT based animal health monitoring

Wearable sensors can send the data to auto monitoring system like clouds through routers and 3G/4G WI-Fi and farmers will get to know the animal's health status automatically. So with the technology farmers will be alerted and in time treatment is possible to avoid the loss.

2.3 Use renewable energy to facilitate - Electricity need for livestock house and its smart use by applying IOT technique – In growing countries like INDIA renewable energy is playing revolutionary role. By 2020 almost 38 % of electricity generation is from renewable sources [4]. With new technology wind and solar powered electricity cost continued to lower down and giving complement to bio energy, hydropower and geothermal technologies. Implementation of solar or wind based renewable power option to supply animal house and also farmer house will excel economic benefit to farmers. Application of IOT in renewable energy will boost to drive efficiency in terms of power utilization and reducing carbon footprints [5]. With smart IOT sensors, technology can take decision in real time. IOT can monitor farmer habit on energy consumption and provide transparent optimization to reduce energy consumption. IOT sensors can track Solar / Wind System preventive maintenance and provide alarm on the same. In case of fault in solar / wind system, IOT can auto shutdown the system to avoid damage. By using renewable energy various operating points like tube, bulbs, cameras, water supply, ventilation...Etc can be powered to save cost on grid electricity. Various sensors can fit to

monitor animal, human, presence at different location and accordingly lights can turn on /off automatically based on brightness need. Animals can be monitored through camera and can apply smart programming to detect abnormal danger like snake or any wild animal entry, unfamiliar human face for theft possibility..Etc. Drinking water and food supply pump can be operated automatically by sensing level and animal presence. Balanced food intake is important for animal health and productivity. Underfeeding and overfeeding both will effect on animal health and cost. Food digestion can be monitored by using sensor and through IOT application food supply decision can be automated.

3. RELATED WORKS

This paper deals with IOT featured electronics under consumer category and technologies for communication and networking for farmers. The focused technologies were like RFID-Radio frequency identification, LR_WPANs - Low rate wireless personal area network, Lora - RongRange, NFC – Near Field Communication, UWB – Ultra wide band, M2M – Machine to Machine, Z (Zensys) waves which enables facilities like monitoring climate, health of cattle, crop, automations in greenhouse, management of livestock and waste from agriculture. Further author has expressed open areas in making aware the end users on available smart solutions, reliability of services to increase success rate like hoc network performance in village area compared to traditional system, mobility management in terms of communication with heterogeneous technologies and low connectivity supporting more data transmission, data confidentiality, device featured with less power and less cost [6].

This document focused approach on IOT based intelligent sheep farming. The proposed infrastructure was collar mounted wireless sensors with internet communication. The IOT modules contain two approaches; first was WSN, used to implement functions like collecting and giving data to users, condition and behaviour monitoring of animals. Second module used to deal with CP, cloud instances, data analysis, storage, and display and data exchange [7].

In this paper author has introduced SDF – Smart Dairy Farming concept based on wireless sensor technology and IOT modules for remote application. Author has approached smart innovations in product and process category. Under product the innovations mentioned on milk process equipment, milking by robotics, milk preservations, and sterilizer and cooling tanks. Under process the innovations mentioned on cattle location like geo-fencing, monitoring cattle activity, behaviour, body parameter and nutrition to understand health issue, reproductive management [8].

Author has mentioned study on IOT role in Indian smart city development, understand policy on IOT in India, find the key features of smart city based on IOT, and understand preference of consumer as per India demographic. The focused IOT applications were monitoring congested traffic, air quality, health of critical patient, energy consumption and its automation and infrastructure management in smart way [9].

This paper covered case study on farming in smart way in Canada, Ontario location. In this article author has mentioned smart IOT application and Smart sensor on cow in the sense on tracking digitally, birth management, testing genomic, crop management driven through sensor and dairy production [10].

In this paper application of edge computing, IOT block chain and artificial intelligent has mentioned for farming and environment monitoring using architecture computer on global edge, state of cattle monitoring in real time and grain with process sustainability and traceability [11].

Author has summarised agriculture IOT application in to four methods: Planting in environment under control, planting in field with open, aquaponics and aquaculture and breeding of livestock. In order to improve long term solution green concept was acquired in technical, finance, operation and management. Technical green concept like network with low power sensors to communicate on wireless, finance green concept like IOT oriented supply chain, Operation green

concept like repairing and recharging network nodes and Management green concept like traceability and quality of product from farm. However although IOT applications promised to reduce the issues still farmer willingness to acquire the IOT green solutions remains a challenge [12].

Author has reported IOT software and hardware architecture design, performance and installation for monitoring continuously. The adapted network proposed on low power and wide area – LORA technique. With simulation using MAC author has proposed a solo gateway to monitor more EDs [13].

In this paper a model based approach; Digital twin has been considered as a road map. Basic idea is to enable farmers to control their farming activity remotely by referring digital information instead standing in real time at farm. Digital twin concept was inspired from one of the space model developed by NASA. In this digital, virtual information about product and its life cycle was captured. Along with this in real time they are connected with real product to give high quality representation. This concept goes far in terms of dynamic action along with static one. That means along with real time it can also product the feature action based on past observation. Because of this farmers can manage day to day farming effectively [14].

In this paper author has designed Ontology model which wads financial efficient along with maintaining quality and safety by managing environment of farm. Major focus provided on diet, health management and environment control. This ontology model was designed to include practical decision based on situation [15].

The main aim was to build monitoring method based on novel scientific to display and measure eating and ruminating pattern of an animal automatically. Rumi Watch pressure sensor for noseband along with data logger and software used to measure and analyse data online. In software to monitor behaviour pattern a generic algorithm was fed without focusing on particular animal. While performing this experiment two software releases performed on Rumi Watch

Converter (RWC) to create two different validation results. So the system measured duration of chewing and display movement of jaw during eating and ruminating pattern. The results from two releases were compared with actual behaviour of an animal to conclude the outcome [16].

In this paper author has proposed WSN based system for monitoring livestock. In this equipment based on IOT along with cloud was used. The sensors were mounted on neck of animal in the form of collar and accordingly animal activity was monitored. This activity information further transferred to cloud to enable farmers to get information in real time on line. The sensor location was tracked through GPS. So each sensor considered as node with GPS environment. In a concept animals were gathered in a group and one leader was formed. With the help of this leader sink node was formed. Other animals transferred their information to sink node through small range network. Then by using cellular network like 4G/3G information were transferred to cloud. In case of issue with leader node i.e. sink node any another animal can become sink node to transfer information through 4G or 3G [17].

This was a review paper with main aim expressed was to study, analyze newly developed applications of IOT to support farmer and agriculture industry. This study enabled an overview about sensors, collection of data, trends in technologies and other vertical applications like water and crop management. Author has studied total 60 publications from 2016 – 18 year span. With respect to review for agriculture and farmer industry the various application of IoT came under crop, water, Livestock, Environment, Smart Farming, soil content and the preferred network fall under Wi-Fi [18].

In this paper author has proposed Industry 4 concept along with IOT. As industry 4 not only deals with wireless sensors, smart machines but also it can collect data about equipment operation, process, orders and supplies. In terms of input from big data it can incorporate data from customers, manufacturers and suppliers. This concept was basically a major influence on data safety. As Livestock and agree products plays a great role on hunger requirement of

population. In modern earth with increasing pollution and global warming, peoples gave more concern to health quality by demanding a nutritious food. So with this farm revolution, smart farming technologies were the key products helping farm industry to deliver quality food requirement. But this also enables a thought on data safety or farmers confidential data stealing. So to avoid this block chain architecture were the option proposed by Author. In block chain stored data and information in the form of encrypted syntax. So to deal with data transmission over an internet by nature it needs private and public keys. So with this block chain will be the best revolution concept to introduce with smart IOT farm and livestock industry [19].

In this research author has established link between cattle illness and monitoring sensors. In this paper study has performed on cattle illness characteristics with respect to behaviour pattern. The aim was to relate suitable sensor from many or one with its reading accuracy for any particular dieses. Further heterogeneous nature database of cattle dieses was mapped using ontological bond with sensor. With this it identified neck wearable non – invasive nature sensor for better health and smart dairy management. The primary acknowledged sensors were Microphone, Temperature and Accelerometer which can be mounted on neck to monitor health parameters. For hypothermia or normothermia detection temperature sensor was identified. For neck and head movement accelerometer sensor was identified. And microphone sensor was identified to detect cow's discomfort, distress or pain with bellowing voice. With all this data a system based on fuzzy rule was built to predict events related to health [20].

4. BIBLIOMETRIC ANALYSIS OF IOT SOLUTIONS FOR FARMERS ON LIVESTOCK MANAGEMENT IN SMART CITY

This part represents bibliometric analysis on IOT solutions for livestock from data base called Scopus. The necessary information is taken from the duration of 01 Jan 2012 to 29th May 2021. The aim of this survey is to explore research by influential authors, funding agencies, areas, countries and institutions [21] and the efforts quantity completed on livestock through IOT

solutions. From data base, 133 research documents extracted from 1st Jan 2012 till 29th May 2021. To understand impact of publication on research field globally, statistical tool like Bibliometric analysis helps on understanding published researches, articles, reviews and conference papers [21]. The visualisation tools like VOS viewer, word cloud and Gephi used to focus on clear and quick visual analysis [21].

Year wise analysis

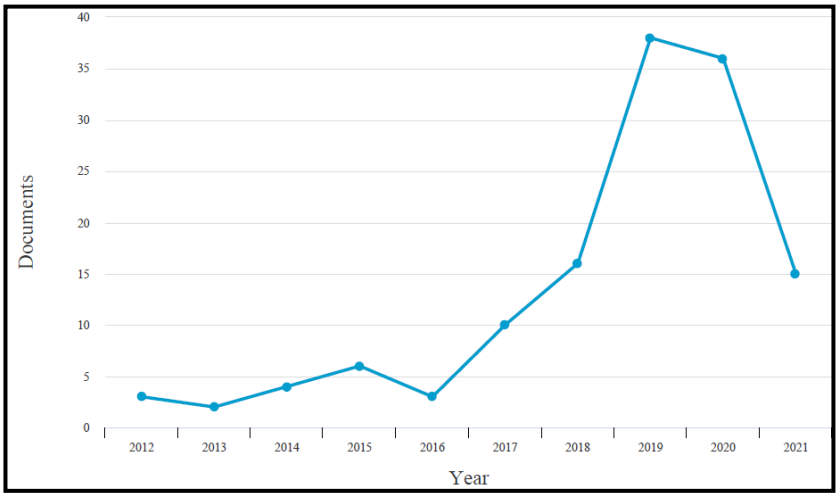

Figure 3. Documents Numbers published per year

Figure 3 and 4 showing document published in the area of IOT, Livestock solutions. Trend shows at 2012 – 2013 published documents very less in numbers but improvement from 2013 to 2015 but again goes down with less than 5 numbers of documents in 2016. From 2017 trend shows drastic improvement till 2019 with documents more than 35 in numbers. Then again in 2020 trend is in downwards on number of documents published the area of IOT, livestock.

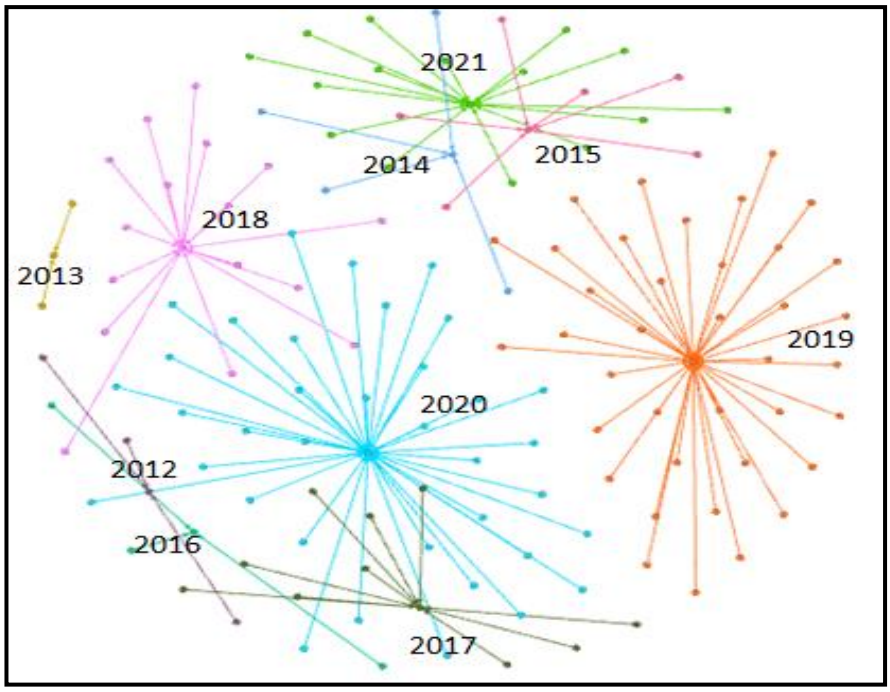

Figure 4. Cluster of Number of documents published per year

Type wise analysis

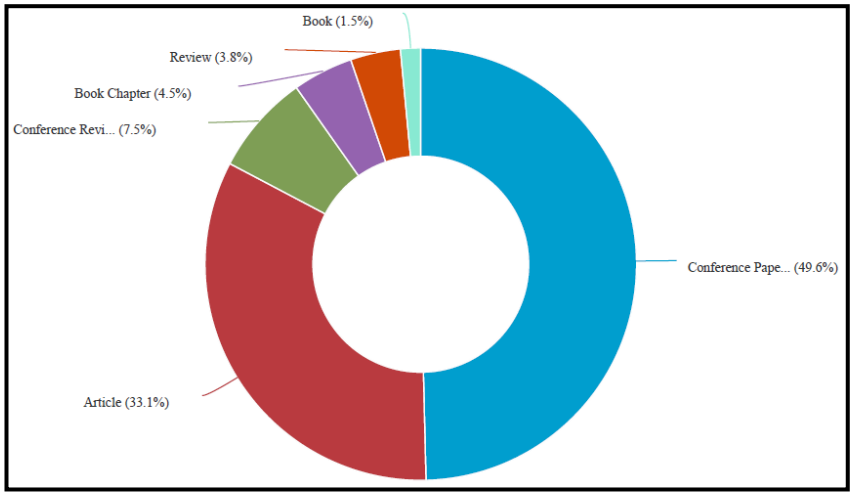

Figure 5. Document distributed as per types

Figure 5 clearly indicates major types of the documents fall under Conference category with 49.6 % of contribution, followed by articles with 33.1 % contribution from 2012 Jan till May 2021 A in the area of IOT, livestock area. Remaining contributions are: Conference review 7.5 %, book chapter 4.5 %, Reviews 3.8 % and Book 1.5 %.

Author wise analysis

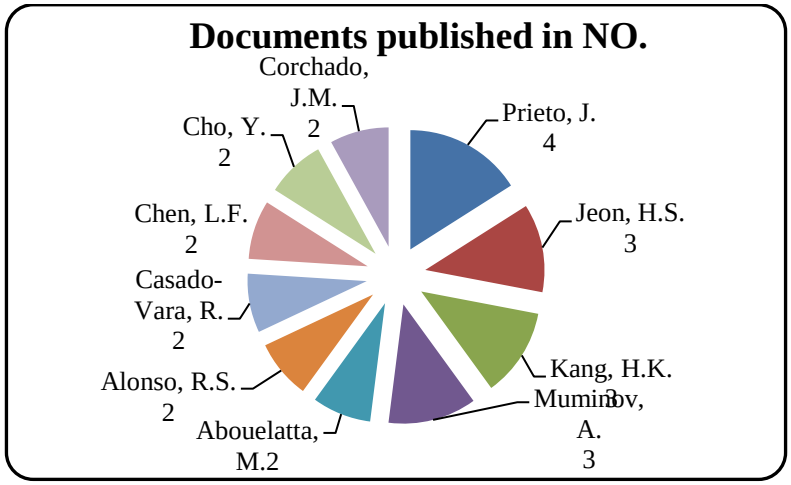

Figure 6. Documents by top ten Authors

Figure 6 indicates graphical representation of publication numbers of top 10 authors in the area of Livestock management through IOT solutions with their great contribution. Further to refer details in Table 1. Author named Prieto, J. contributing more with 4 numbers of documents followed by Jeon, H. S, Kang, H.K, Muminov, A with each 3 numbers of documents.

Table1. Details of ten top authors with number of published documents

Sr. No	Name of the Author	Number of Publications.
1	Prieto, J.	4
2	Jeon, H.S.	3
3	Kang, H.K.	3
4	Muminov, A.	3
5	Abouelatta, M.	2
6	Alonso, R.S.	2
7	Casado-Vara, R.	2
8	Chen, L.F.	2
9	Cho, Y.	2
10	Corchado, J.M.	2

Subject area wise analysis

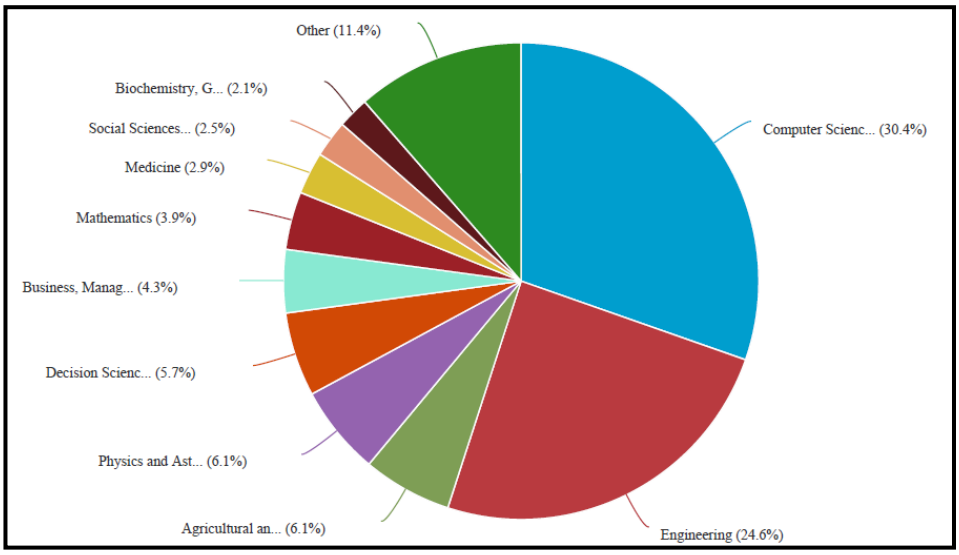

Figure 7. Document as per subject area

Figure 7, Subject area graph shows more contribution under Computer Science with 30.4 %. Engineering category own 24.6 % contribution. Table 2 represents details on number of publications per subject wise.

Table2. Top ten publications per Subject

Sr no	Subject	Number of Publications
1	Computer Science	85
2	Engineering	69
3	Agricultural and Biological Sciences	17
4	Physics and Astronomy	17
5	Decision Sciences	16
6	Business, Management and Accounting	12
7	Mathematics	11
8	Medicine	8
9	Social Sciences	7
10	Biochemistry, Genetics and Molecular Biology	6

Affiliation wise analysis

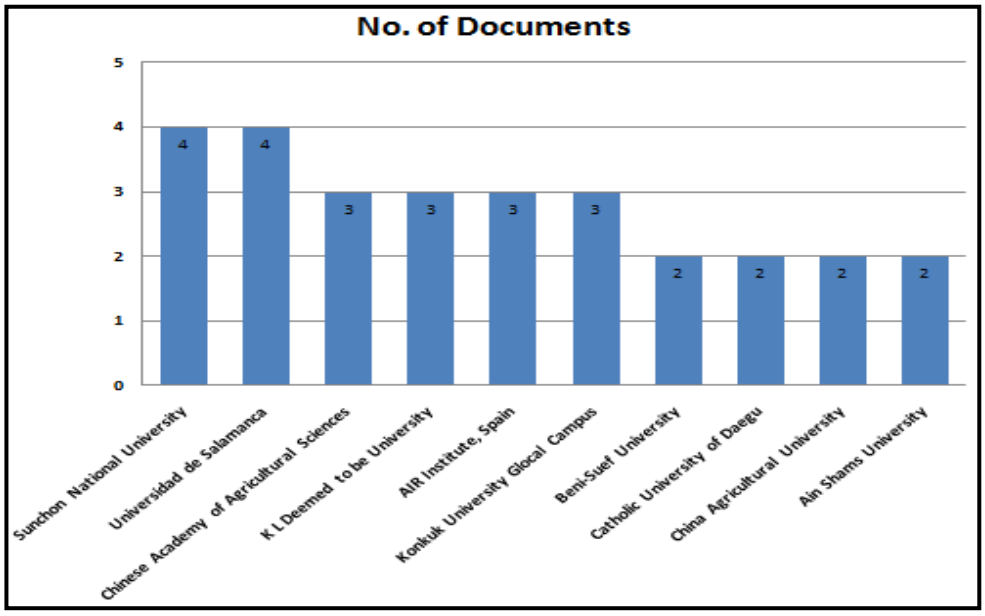

Figure 8. Number of documents published by top affiliation

Figure 8 shows top 10 affiliations contributing maximum release of document under IOT, Livestock area. Out of which 'Sunchon National University' and 'Universidad de Salamanca' with are contributing more with 4 numbers of publication each. Further to understand rest contribution details are mentioned in Table 3.

Table3. Ten top affiliations with Numbers of publication

Sr. No	Affiliation Details	No. of Documents
1	Sunchon National University	4
2	Universidad de Salamanca	4
3	Chinese Academy of Agricultural Sciences	3
4	K L Deemed to be University	3
5	AIR Institute, Spain	3
6	Konkuk University Glocal Campus	3
7	Beni-Suef University	2
8	Catholic University of Daegu	2
9	China Agricultural University	2
10	Ain Shams University	2

Country wise trend

From figure 9 we got to know top 10 Nations contributing documents on IOT, Livestock area. China and India are the first two Major contributor under this topic with total 21 and 19 numbers of documents published each from Jan 2010 to May 2021 duration.

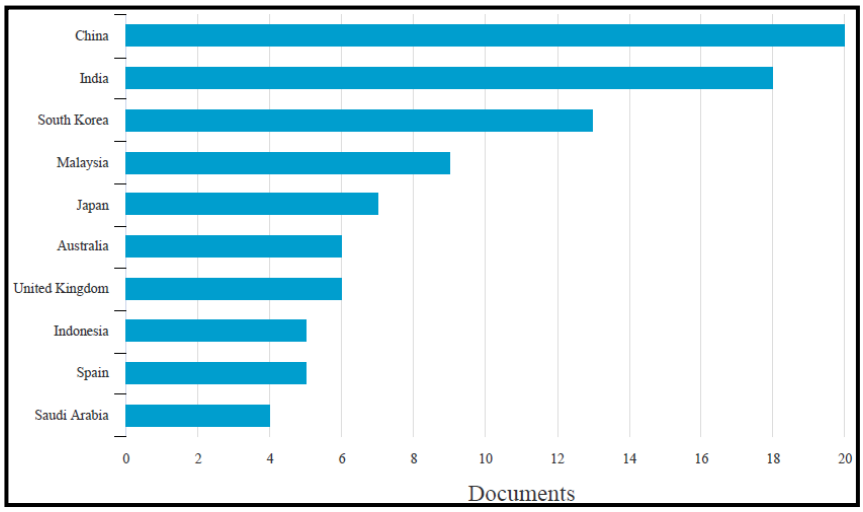

Figure 9. Top 10 countries based on number of publications

Figure 10. Geographical location of countries involved in research Accessed on 29th May 2021 (Source: http://www.scopus.com)

Figure 10 represents Geographical location of countries which contributes research in the area of IOT for livestock management. Details accessed on 29th May 2021 from http://www.scopus.com

Sponsor wise

Figure 11 gives details of 10 top sponsors contributing in this area. Out of which 'National Research Foundation of Korea' is the top first with 5 documents. Second top sponsors are 'European Regional Development Fund', 'Institute for Information and Communications Technology Promotion' and 'Ministry of Science, ICT and Future Planning' with 3 documents each. Table 3 indicates detail information of top 10 cited documents published in area of live stock management through IOT solution.

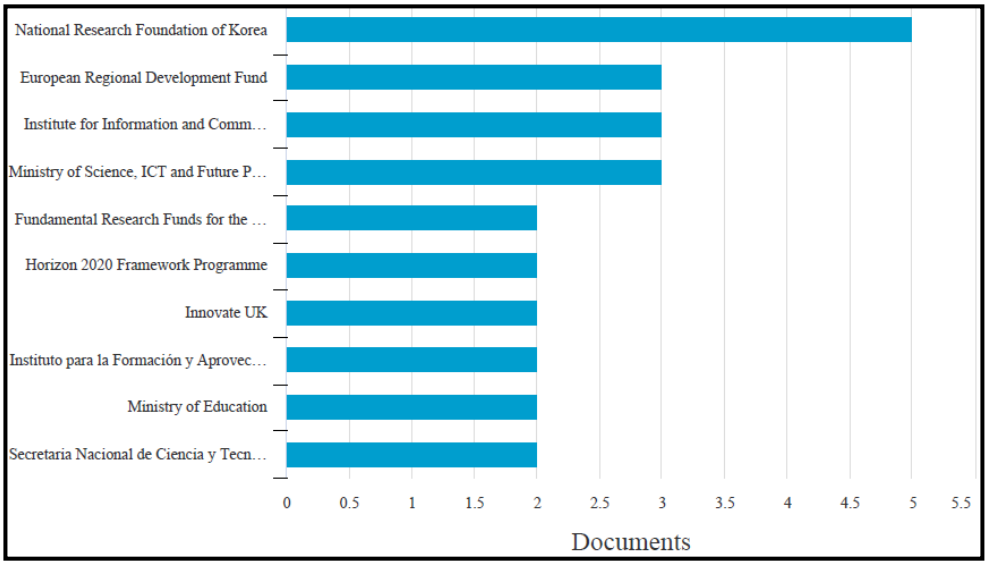

Figure 11. Documents by Sponsor

Citation analysis

Table 4. Top ten cited documents published

Sr. No	Title	Authors	Year	Cited by	Journal Title
1	The internet of things in agriculture for sustainable rural development	Dlodlo N., Kalezhi J.	2015	92	Proceedings of 2015 International Conference on Emerging Trends in Networks and Computer Communications, ETNCC 2015
2	A Life Cycle Framework of Green IoT-Based Agriculture and Its Finance, Operation, and Management Issues	Ruan J., Wang Y., Chan F.T.S., Hu X., Zhao M., Zhu F., Shi B., Shi Y., Lin F.	2019	53	IEEE Communications Magazine

3	State-of-the-art Review for Internet of Things in Agriculture	Li D., Yang H.	2018	38	Nongye Jixie Xuebao/Transactions of the Chinese Society for Agricultural Machinery
4	An intelligent Edge-IoT platform for monitoring livestock and crops in a dairy farming scenario	Alonso R.S., SittÃ³n-Candanedo I., GarcÃa Ã“., Prieto J., RodrÃ-guez-GonzÃ¡lez S.	2020	35	Ad Hoc Networks
5	Environmental control system based on IOT for nursery pig house	Zhu W., Dai C., Huang P.	2012	30	Nongye Gongcheng Xuebao/Transactions of the Chinese Society of Agricultural Engineering
6	Application and innovation strategy of agricultural Internet of Things	Li J., Guo M., Gao L.	2015	29	Nongye Gongcheng Xuebao/Transactions of the Chinese Society of Agricultural Engineering
7	Adoption of the Internet of Things (IoT) in agriculture and smart farming towards urban greening: A review	Madushanki A.A.R., Halgamuge M.N., Wirasagoda W.A.H.S., Syed A.	2019	27	International Journal of Advanced Computer Science and Applications
8	Review on application of Internet of Things technology in animal husbandry in China	Xiong B., Yang Z., Yang L., Pan X.	2015	16	Nongye Gongcheng Xuebao/Transactions of the Chinese Society of Agricultural Engineering
9	IoT solutions for precision agriculture	Andrew R.C., Malekian R., Bogatinoska D.C.	2018	16	2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2018 - Proceedings
10	Smart poultry management : Smart sensors, big data, and internet of things	Astill J, Dara, R.A., Fraser, EDG., Roberts, B., Sharif, S.	2020	14	Electronics

Table 4 represents top ten highly cited publications and Table 5 represents citation analysis of number of publication with respect to year and figure 12 represents citations year wise graphical trend on IOT, livestock from Jan 1st 2012 till 29 May 2021

Table 5. Citation analysis of publications

Year	Cited By	Year	Cited By
2012	0	2017	35
2013	6	2018	35
2014	4	2019	132
2015	5	2020	231
2016	20	2021	125

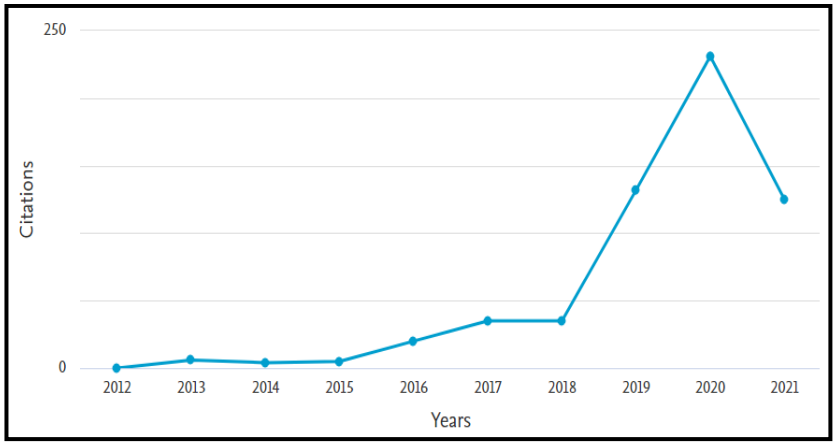

Figure 12. Citation analysis of Publication

Language wise trend analysis

Figure 13 represents language wise analysis. More publications are in English with 95 %, only 4% publications in Chinese language and 1 % in Spanish language.

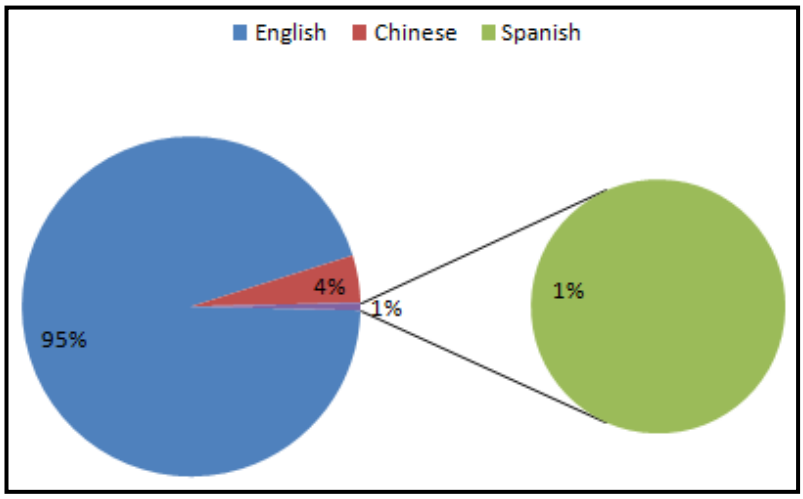

Figure 13. Document contribution as per language

Table 6 represents details on number of publications per language. In English language total 126 numbers of publications from Jan 2012 till 29 May 2021.

Table 6. Number of documents published as per language

Sr. No.	Language	No of Documents
1	English	126
2	Chinese	6
3	Spanish	1

Word wise

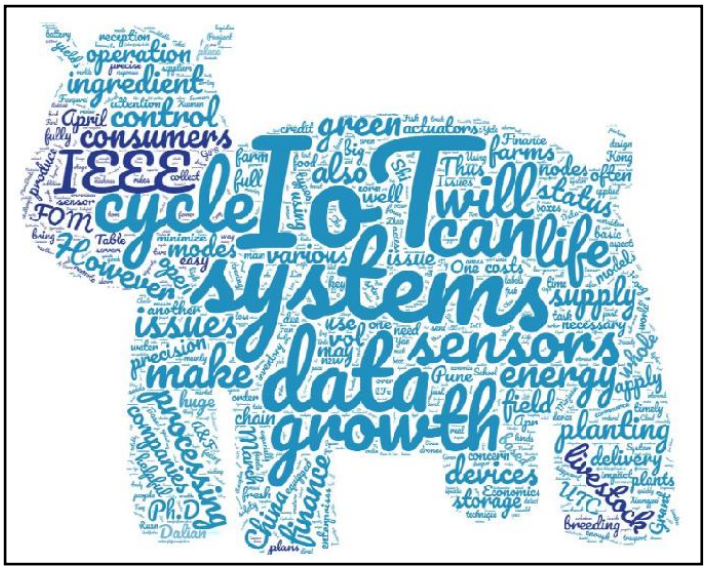

Figure 14. The words in the publications are visualised with world cloud in IOT solutions on livestock management

Figure 14 represents world cloud visualised pattern of words in the publication under IOT solution for livestock management.

Key words wise

2012

- **internet of things (iot)** 1 paper
- **monitoring** 1 paper
- **crop monitoring** 1 paper
- **embedded systems** 1 paper
- **environmental engineering** 1 paper
- **environmental factor** 1 paper
- **intelligent decision** 1 paper
- **nursery pig house** 1 paper
- **the internet of things** 1 paper
- **zigbee wireless network** 1 paper

2013

- **iot** 1 paper
- **rfid** 1 paper
- **middleware** 1 paper
- **branch and bound algorithm** 1 paper
- **halal** 1 paper
- **livestock product** 1 paper
- **market management** 1 paper
- **pigwise** 1 paper
- **virtus** 1 paper
- **xmpp** 1 paper

2014

- **ecological learning** 2 papers
- **learning design** 2 papers
- **open learning** 2 papers
- **supply** 2 papers
- **internet of things** 1 paper
- **sensors** 1 paper
- **agriculture production process** 1 paper
- **application system** 1 paper
- **intelligent control** 1 paper
- **intelligent monitoring** 1 paper

Figure 15. Main Keywords with respect to years from 2012 to 2021 Accessed on 29 May 2021 (Source: http://www.scopus.com)

Figure 15 represents top ten main keywords appearing year wise from 2012 to May 2021 on IOT, Livestock publications. Figure 16 represents Scopus publication of co – occurrence of the keywords in cluster format. The interrelation shows Internet of things and agriculture, monitoring, IOT, livestock are co occurring most frequently.

Figure 17 represents Sankey graph between main authors, main journals and main keywords in publications. First column represents main author influenced and linked with important keywords mentioned in second column and third column represents main journals where the research was published. Figure 18 represents information of Sankey graph in tabular form

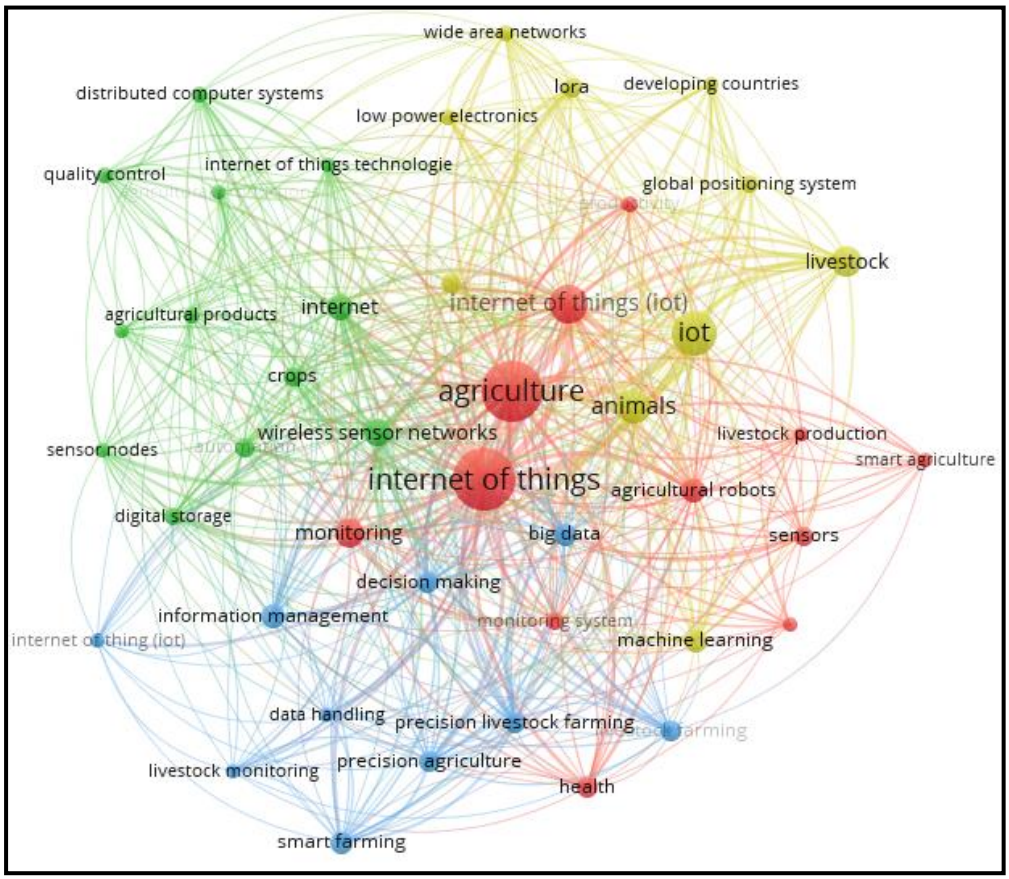

Figure 16. Cluster of Co occurrence of all keywords

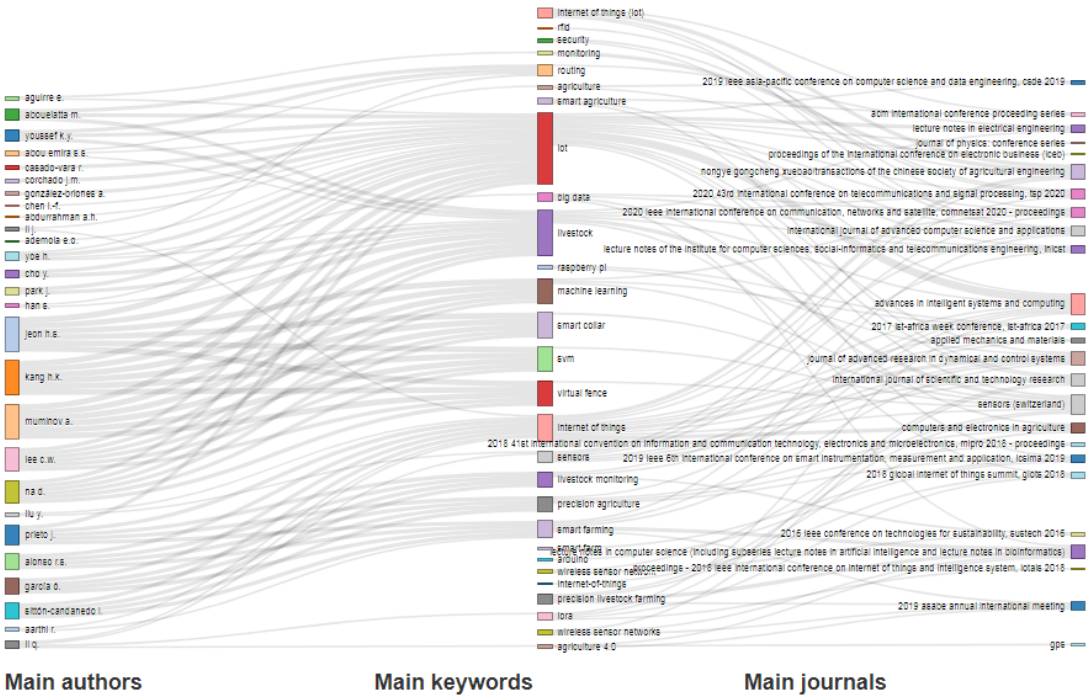

Figure 17. Sankey Graph -Main Authors, main keywords, and main journals.

Main authors

- **[no author name available]** (10 papers)
- **prieto j.** (4 papers)
- **jeon h.s.** (3 papers)
- **kang h.k.** (3 papers)
- **muminov a.** (3 papers)
- **abouelatta m.** (2 papers)
- **alonso r.s.** (2 papers)
- **casado-vara r.** (2 papers)
- **chen l.-f.** (2 papers)
- **cho y.** (2 papers)
- **corchado j.m.** (2 papers)
- **garcía ó.** (2 papers)
- **gonzález-briones a.** (2 papers)
- **han s.** (2 papers)
- **lee c.w.** (2 papers)
- **li j.** (2 papers)
- **li q.** (2 papers)
- **liu y.** (2 papers)
- **na d.** (2 papers)
- **park j.** (2 papers)
- **sittón-candanedo i.** (2 papers)
- **wang y.** (2 papers)
- **yoe h.** (2 papers)
- **youssef k.y.** (2 papers)
- **aarthi r.** (1 papers)
- **abdurrahman a.h.** (1 papers)
- **abou emira s.s.** (1 papers)
- **ademola e.o.** (1 papers)
- **afdal** (1 papers)
- **aguirre e.** (1 papers)

Main keywords

- **iot** (43 papers)
- **internet of things** (26 papers)
- **livestock** (16 papers)
- **smart farming** (11 papers)
- **machine learning** (10 papers)
- **agriculture** (8 papers)
- **big data** (8 papers)
- **lora** (8 papers)
- **precision agriculture** (8 papers)
- **precision livestock farming** (8 papers)
- **sensors** (8 papers)
- **wireless sensor networks** (8 papers)
- **internet of things (iot)** (7 papers)
- **livestock monitoring** (5 papers)
- **monitoring** (5 papers)
- **smart agriculture** (5 papers)
- **cloud computing** (4 papers)
- **smart farm** (4 papers)
- **wireless sensor network** (4 papers)
- **arduino** (3 papers)
- **gps** (3 papers)
- **internet-of-things** (3 papers)
- **raspberry pi** (3 papers)
- **rfid** (3 papers)
- **routing** (3 papers)
- **security** (3 papers)
- **smart collar** (3 papers)
- **svm** (3 papers)
- **virtual fence** (3 papers)
- **agriculture 4.0** (2 papers)

Main journals

- **advances in intelligent systems and computing** (7 papers)
- **lecture notes in electrical engineering** (5 papers)
- **nongye gongcheng xuebao/transactions of the chinese society of agricultural engineering** (5 papers)
- **computers and electronics in agriculture** (3 papers)
- **journal of advanced research in dynamical and control systems** (3 papers)
- **lecture notes in computer science (including subseries lecture notes in artificial intelligence and lecture notes in bioinformatics)** (3 papers)
- **sensors (switzerland)** (3 papers)
- **2020 ieee international conference on communication, networks and satellite, comnetsat 2020 - proceedings** (2 papers)
- **acm international conference proceeding series** (2 papers)
- **applied mechanics and materials** (2 papers)
- **ceur workshop proceedings** (2 papers)
- **chemical, gas, and biosensors for internet of things and related applications** (2 papers)
- **international journal of advanced computer science and applications** (2 papers)
- **international journal of scientific and technology research** (2 papers)
- **iop conference series: materials science and engineering** (2 papers)
- **journal of physics: conference series** (2 papers)
- **lecture notes of the institute for computer sciences, social-informatics and telecommunications engineering, lnicst** (2 papers)

- proceedings - 2018 ieee international conference on internet of things and intelligence system, iotais 2018 (2 papers)
- proceedings of the international conference on electronic business (iceb) (2 papers)
- 2016 ieee conference on technologies for sustainability, sustech 2016 (1 papers)
- 2017 1st international conference on next generation computing applications, nextcomp 2017 (1 papers)
- 2017 25th telecommunications forum, telfor 2017 - proceedings (1 papers)
- 2017 ist-africa week conference, ist-africa 2017 (1 papers)
- 2018 41st international convention on information and communication technology, electronics and microelectronics, mipro 2018 - proceedings (1 papers)
- 2018 global internet of things summit, giots 2018 (1 papers)
- 2019 asabe annual international meeting (1 papers)
- 2019 ieee 1st global conference on life sciences and technologies, lifetech 2019 (1 papers)
- 2019 ieee 6th international conference on smart instrumentation, measurement and application, icsima 2019 (1 papers)
- 2019 ieee asia-pacific conference on computer science and data engineering, csde 2019 (1 papers)
- 2020 43rd international conference on telecommunications and signal processing, tsp 2020 (1 papers)

Figure 18. Tabular Information of Sankey Graph in Figure 17.

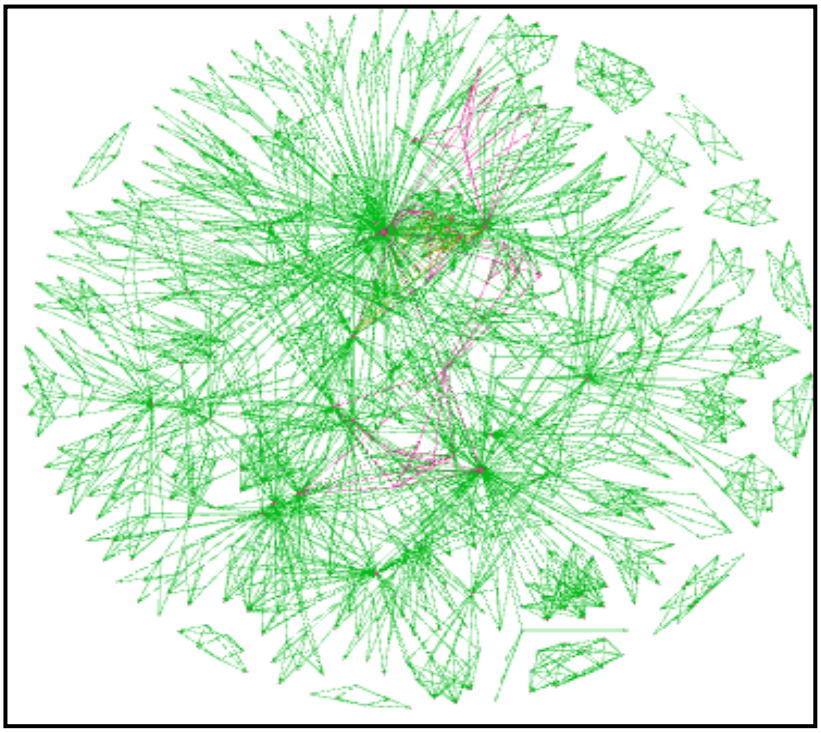

Figure 19. Author and author keyword co appearing in the same papers

Figure 19 represents author and author keyword co appearing in the same paper. Figure 20 represents year wise top journal of Scopus publication in the area of IOT, livestock from 2012 to May 2021.

2012

- nongye gongcheng xuebao/transactions of the chinese society of agricultural engineering 1 paper
- applied mechanics and materials 1 paper

2013

- lecture notes in electrical engineering 1 paper
- precision livestock farming 2013 - papers presented at the 6th european conference on precision livestock farming, ecplf 2013 1 paper

2014

- applied mechanics and materials 1 paper
- advanced materials research 1 paper
- energy education science and technology part a: energy science and research 1 paper
- journal of chemical and pharmaceutical research 1 paper

2015

- nongye gongcheng xuebao/transactions of the chinese society of agricultural engineering 3 papers
- proceedings of the international conference on electronic business (iceb) 2 papers
- international journal of smart home 1 paper

2016

- international journal of simulation: systems, science and technology 1 paper
- proceedings of 2015 international conference on emerging trends in networks and computer communications, etncc 2015 1 paper
- proceedings of the annual international conference on mobile computing and networking, mobicom 1 paper

2017

- nongye gongcheng xuebao/transactions of the chinese society of agricultural engineering 1 paper
- 2016 ieee conference on technologies for sustainability, sustech 2016 1 paper
- 2017 1st international conference on next generation computing applications, nextcomp 2017 1 paper
- 2017 ist-africa week conference, ist-africa 2017 1 paper
- international journal of services, technology and management 1 paper
- powering the internet of things with 5g networks 1 paper
- proceedings of 2016 5th international conference on computer science and network technology, iccsnt 2016 1 paper
- proceedings of the 29th international business information management association conference - education excellence and innovation management through vision 2020: from regional development sustainability to global economic growth 1 paper
- proceedings of the international conference on sensing technology, icst 1 paper
- ubi-media 2017 - proceedings of the 10th international conference on ubi-media computing and workshops with the 4th international workshop on advanced e-learning and the 1st international workshop on multimedia and iot: networks, systems and applications 1 paper

2019

- journal of advanced research in dynamical and control systems 2 papers
- sensors (switzerland) 2 papers
- acm international conference proceeding series 2 papers
- ceur workshop proceedings 2 papers
- chemical, gas, and biosensors for internet of things and related applications 2 papers
- proceedings - 2018 ieee international conference on internet of things and intelligence system, iotais 2018 2 papers
- lecture notes in electrical engineering 1 paper
- lecture notes in computer science (including subseries lecture notes in artificial intelligence and lecture notes in bioinformatics) 1 paper
- international journal of advanced computer science and applications 1 paper
- international journal of scientific and technology research 1 paper

2018

- lecture notes in electrical engineering 1 paper
- journal of advanced research in dynamical and control systems 1 paper
- journal of physics: conference series 1 paper
- 2017 25th telecommunications forum, telfor 2017 - proceedings 1 paper
- 2018 41st international convention on information and communication technology, electronics and microelectronics, mipro 2018 - proceedings 1 paper
- 2018 global internet of things summit, giots 2018 1 paper
- ieee world forum on internet of things, wf-iot 2018 - proceedings 1 paper
- iet conference publications 1 paper
- international journal of engineering and technology(uae) 1 paper
- international symposium on wireless personal multimedia communications, wpmc 1 paper

2020

- advances in intelligent systems and computing 3 papers
- computers and electronics in agriculture 3 papers
- lecture notes in electrical engineering 2 papers
- lecture notes in computer science (including subseries lecture notes in artificial intelligence and lecture notes in bioinformatics) 2 papers
- iop conference series: materials science and engineering 2 papers
- lecture notes of the institute for computer sciences, social-informatics and telecommunications engineering, lnicst 2 papers
- sensors (switzerland) 1 paper
- 2020 ieee international conference on communication, networks and satellite, comnetsat 2020 - proceedings 1 paper
- international journal of advanced computer science and applications 1 paper
- international journal of scientific and technology research 1 paper

Figure 20. Top Journals per year

CONCLUSION

With increasing population, urban cities are expanding and merging nearby town / villages in city. So the future of smart city is dependent upon strong partnership with urban and rural community. The IOT – Internet of thing phenomenon in smart city is significant to boost the country ecosystem as it can increase quantity and quality both hand in hand. The research presented different IOT based technologies for farmers to manage livestock, cattle's day to day organization smartly. Nowadays, we can find IoT devices and applications in almost all sectors of the society. The system accurately and efficiently monitors livestock behaviour and detect animals status in terms of physiological and health. This activity is advanced by one of the potential infrastructures called IOT with its unlimited capabilities in terms of communication, cloud system, hardware and user-friendly applications.

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